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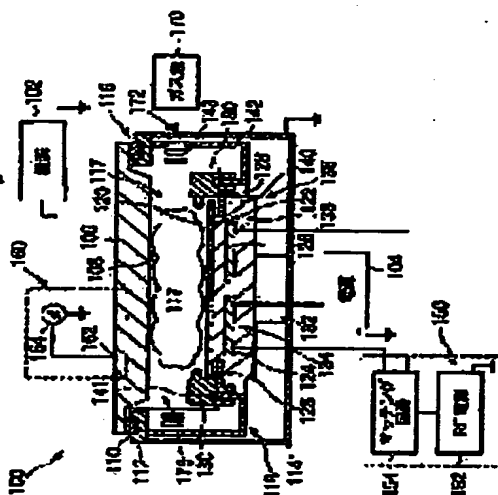
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(54) METHOD AND DEVICE FOR MONITORING SEMICONDUCTOR WAFER PROCESSING

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method and a device for detecting of a plasma.**SOLUTION:** A device is provided with a contact member, which is exposed to a plasma forming region in a semiconductor wafer processing chamber 116 and which floats electrically. The floating contact is connected to a measurement device 164. When a plasma 177 exists in the plasma forming region, the plasma induces a voltage on the floating contact 162, and the voltage is detected with the measurement device.

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CLAIMS

[Claim(s)]

- [Claim 1] Equipment characterized by having the measurement device which is equipment for detecting the plasma in a plasma treatment chamber, and is combined with the contact which has floated electrically so that potential may change when put to the above-mentioned plasma, and the above-mentioned floating contact.
- [Claim 2] The above-mentioned floating contact is equipment according to claim 1 characterized by consisting of a processing chamber target.
- [Claim 3] The above-mentioned floating contact is equipment according to claim 1 characterized by obtaining bias voltage when put to the above-mentioned plasma.
- [Claim 4] The above-mentioned bias voltage is equipment according to claim 3 characterized by being about 3.6 thru/or about 7.0 volts.
- [Claim 5] The above-mentioned measurement device is equipment according to claim 1 characterized by having the voltmeter further.
- [Claim 6] Equipment according to claim 1 characterized by having further the electrostatic chuck arranged in the above-mentioned processing chamber.
- [Claim 7] The above-mentioned floating contact is equipment according to claim 1 characterized by having further the contact member which is combined with the above-mentioned measurement device and put to the above-mentioned plasma, and the insulating member which insulates the above-mentioned contact member from the above-mentioned processing chamber electrically.
- [Claim 8] The above-mentioned measurement device is equipment according to claim 7 characterized by having the voltmeter further.
- [Claim 9] Equipment characterized by having the processing chamber which has the wall and lid which are equipment for detecting the plasma and demarcate a plasma treatment field, the target which approaches the above-mentioned lid, is arranged and is put to the above-mentioned plasma treatment field, and the measurement device combined with the above-mentioned target.
- [Claim 10] The above-mentioned processing chamber is equipment according to claim 9 characterized by having further the electrostatic chuck which is arranged in the above-mentioned processing chamber and has at least one embedded electrode.
- [Claim 11] The above-mentioned processing chamber is equipment according to claim 9 characterized by having the cleaning system further.
- [Claim 12] The above-mentioned target is equipment according to claim 9 characterized by obtaining bias voltage when put to the above-mentioned plasma.
- [Claim 13] The above-mentioned bias voltage is equipment according to claim 12 characterized by being about 3.6 thru/or about 7.0 volts.
- [Claim 14] The above-mentioned measurement device is equipment according to claim 9 characterized by having the voltmeter further.
- [Claim 15] The above-mentioned processing chamber is equipment according to claim 9 characterized by being a physical-vapor-deposition chamber.
- [Claim 16] Equipment according to claim 11 characterized by having further the power source which floats electrically from touch-down when it is combined with the above-mentioned target and the above-mentioned cleaning system is energized.
- [Claim 17] The approach which is an approach for detecting that the plasma exists in a processing chamber, and is characterized by including the step which floats electrically the contact put to the plasma treatment field of the above-mentioned processing chamber, the step which makes the plasma ignite into the above-mentioned processing field, and the step which measures the voltage level of the above-mentioned contact.
- [Claim 18] The above-mentioned contact is an approach according to claim 17 characterized by being a physical-vapor-deposition chamber target.
- [Claim 19] The step which floats the above-mentioned contact electrically is an approach according to claim 18 characterized by including further the step which insulates the power source combined with the above-mentioned target.
- [Claim 20] The above-mentioned voltage level of the above-mentioned contact is an approach according to claim 17 characterized by induction being carried out by the above-mentioned plasma.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Generally this invention relates to the equipment for supervising the processing in a semi-conductor processing chamber, and the approach relevant to it. If it states in detail, this invention relates to the equipment which detects the plasma in a processing chamber.

[0002]

[Description of the Prior Art] In many semi-conductor processing actuation, it is critically-like to continue making the substrate under processing stand it still. In order to attain these objects, electrostatic ** machine and/or a substrate maintenance device like a vacuum chuck are formed in the substrate support pedestal, and hold a substrate on the support front face of a pedestal in many cases. An electrostatic chuck has the energization under processing, and quick **** time amount; possibility of damaging a substrate is low, and the pedestal in which the electrostatic chuck was prepared as a maintenance device since all the front faces of a wafer were exposed is chosen widely.

[0003] An electrostatic chuck is operated by impressing direct current voltage to the electrode embedded in dielectric materials. The impressed electrical potential difference generates a charge on the support front face of an electrostatic chuck, and makes the background of the substrate with which this charge touches a support front face carry out induction of the electrostatic potential of reversed polarity. This electrostatic potential fixes a substrate during processing in a pedestal.

[0004] The specific resistance on the front face of support is a parameter important for chucking and the DECHAKKINGU engine performance (namely, clamping of the substrate on the front face of support and the repeat of release of the substrate from a support front face). By maintaining the property specific resistance which the support front face meant, migration of the charge which weakens the chucking force, and the flow of a current are prevented. The contamination on a chuck front face makes the specific resistance of a chuck increase, and changes the chucking engine performance parasitically by it in many cases. Therefore, in order to make it function as reliable, it must be made for there to have to be a contamination in the support front face of an electrostatic chuck. If substantial current leakage occurs or residual charge is established in an electrostatic chuck, the chucking force will decrease or it will come to be lost thoroughly.

[0005] The general configuration of electrostatic chuck surface contamination is absorption of gas in case aeration of the chamber is carried out to atmospheric air, or a reaction on gas and the front face of support of an electrostatic chuck (typically ceramic ingredient). If the support front face containing residual atmospheric gas is put to an elevated temperature during wafer processing, the contamination film of low specific resistance will be formed in the whole support front face. If time amount passes, aeration of the chamber is repeatedly carried out during processing of many wafers and it is put to an elevated temperature, the thickness of a contamination film will increase and specific resistance will fall. When the specific resistance of a contamination is lower than the specific resistance of a ceramic, an electrostatic chuck begins to set up the charge of reversed polarity in the contamination film itself, and it is not made it to carry out induction to the substrate on a contamination film. Therefore, the chucking force between a substrate and a pedestal is lost.

[0006] It depends on the operating temperature of an electrostatic chuck for the effectiveness of a contamination film exerted on the chucking engine performance at the thickness of a contamination film and specific resistance, and a list. Since the bulk specific resistance of an electrostatic chuck is inversely proportional to the temperature, in low temperature to which bulk specific resistance becomes higher, the effectiveness of a conductive contamination film becomes much more serious. If the weak chucking force is observed in an elevated temperature, **** will become that therefore, an electrostatic chuck does not almost have the chucking force less in low temperature. The master variables which govern formation of the contamination film to a chuck top are time amount while being in operating temperature and its temperature, and time amount put to atmospheric air.

[0007] A contamination film continues growing on the front face of an electrostatic chuck until the formed contamination film is removed by maintenance procedure. Maintenance is carried out periodically and removes a contamination film from an electrostatic chuck support front face.

[0008] One maintenance procedure consists of low power plasma etching to which the spatter of the contamination is carried out from the support front face of an electrostatic (in situ) chuck with the location. In order to carry out this maintenance procedure, it is installed on RF power source, an automatic-tuning RF matching circuit, and the

chamber that can apply a service controller. The plasma is generated in a processing chamber by impressing RF power to the electrode in an electrostatic chuck, making argon gas flow into a chamber. Bias of the chuck is carried out to negative to the plasma, and it makes argon ion collide with a chuck front face, and carries out the "sputter" of the contamination layer to ion. Plasma etching was carried out and the electrostatic chuck after all the contaminations were removed has recovered the condition of holding a substrate to the following maintenance service spacing.

[0009] The problem of one using low power plasma etching **** is that it is difficult to check that the plasma has ignited, i.e., cleaning or an etching cycle was started. The aperture is prepared in some processing chamber so that the interior of a chamber can be seen. Therefore, a user can identify existence of the plasma visually by seeing the "glow" of the plasma. However, the aperture is not prepared in the location which can see the plasma easily to all chambers, the processing kit is attached in other chambers, and the look between an aperture and the part of the chamber which shuts up the plasma is interrupted in many cases. Therefore, it is common for it to be very difficult to attest existence of the plasma.

[0010] A cleaning process must be repeated if it does not succeed in clearance of the contamination from an electrostatic chuck. This repeat of maintenance procedure makes the down-time of a processing chamber increase, and **** and reduces a production throughput. Therefore, in a field, the want to the equipment which makes easy detection of the plasma in a semi-conductor processing chamber exists for the time being.

[0011]

[Summary of the Invention] The defect accompanying the conventional technique is canceled [that the plasma exists in a semi-conductor processing chamber, and] by the plasma detection system determined easily, the plasma detection system is equipped with the floating contact (namely, --- from touch-down --- electric --- --- floating --- --- the contact to require) which is combined with the measurement device and put to the plasma formation field of a processing chamber. A measurement device detects the increment in the electrical potential difference on the floating contact which directs that the plasma exists in a processing chamber when the plasma ignites in a plasma formation field therefore.

[0012] The approach of detecting existence of the plasma in a processing chamber is also indicated. This approach contains the step which floats electrically the contact put to the plasma formation field of a processing chamber, the step which the plasma is made to ignite in a plasma formation field, and the step which measures the voltage level of contact.

[0013] He can understand this invention easily from the explanation which refers to the following accompanying drawings. In order to make an understanding easy, the same number is given to the same element common to both drawings as much as possible.

[0014]

[Embodiment of the Invention] Drawing 1 is the schematic diagram showing the plasma detection system 160 of this invention incorporated in the semiconductor wafer processing system 100. This invention directs effectively that the plasma exists in the semi-conductor processing system 100. Generally this invention is applicable to a physical vapor deposition (PVD), i.e., a sputtering chamber, a chemical-vacuum-deposition (CVD) chamber, and the deposition chamber of the semiconductor wafer processing system containing an ion-implantation chamber. Moreover, in order to hold a substrate in the chamber which has plasma treatment, i.e., a cleaning cycle, this invention is applicable if the electrostatic chuck is used.

[0015] As an example, drawing 1 is drawing showing the outline of PVD100, i.e., a sputtering system. The system 100 contains the processing chamber 116, the gas panel 170, the cleaning system 150, and the plasma detection system 160. The substrate 120 (for example, semiconductor wafer) is positioned in the processing chamber 116 during processing. An ordinary hardware component like a vacuum pump should not be omitted for clearing.

[0016] The illustrated processing chamber 116 contains the retaining ring 112 attached in the top of the grounded cylindrical shape chamber wall 114 and the chamber wall 114. The target plate 106 has been arranged on the chamber wall 114, closed the processing chamber 116, and has demarcated the internal volume 117. The target plate 106 is electrically insulated from the chamber wall 114 by the annular insulator 110 which has separated the target plate 106 and the retaining ring 112. Generally, in order to guarantee the integrity of the vacuum in the processing chamber 116, the vacuum seal is constituted on an insulator 110 and in the bottom using an O ring (not shown).

[0017] Manufacturing the target plate 106 with the ingredient which becomes a deposition kind can also include the coating 108 of a deposition kind. In order to make a sputtering process easy, high-tension DC power supply 102 are connected between the target plate 106 and the chamber wall 114 grounded electrically.

[0018] The electrostatic chuck 136 holds and supports a substrate 120 in the processing chamber 116. The electrostatic chuck 136 is attached on the rise-and-fall system 132 for which the electrostatic chuck 136 is made to exercise vertically. The flange 140 is extended from the periphery of the electrostatic chuck 136, and the alignment ring 128 is supported.

[0019] In the gestalt of 1 operation of this invention, the electrostatic chuck 136 contains one currently embedded in the ceramic chuck body 138 or the electrode 134 124 beyond it, for example, the 1st electrode, and the 2nd electrode 126. Electrodes 124 and 126 are driven with the electrical potential difference from the electrode power source 104 by ordinary technique, answer impression of an electrical potential difference, and clamp a substrate 120 electrostatic on the support front face 122 of the electrostatic chuck 136.

[0020] The ceramic chuck body 138 is manufactured by aluminium nitride or boron nitride. Such an ingredient of

comparatively low specific resistance promotes the Johnsen Rahbeck effect during high temperature processing. Other elevated-temperature chuck ingredients also with a useful low specific resistance ceramic like the alumina doped with titanium oxide or chrome oxide are formed comparatively. If the electrostatic chuck 138 is used only within low temperature, the chuck body 138 will be formed using other ceramics and/or dielectric ingredients like an alumina.

[0021] Since the example of a ceramic electrostatic chuck is indicated by U.S. Pat. No. 5,147,121 on May 26, 1992, and U.S. Pat. No. 5,656,093 on August 12, 1997, please refer to. Since the example of a non-ceramic electrostatic chuck is indicated by U.S. Pat. No. 4,184,188 on January 15, 1980, and U.S. Pat. No. 4,384,918 on May 24, 1983, please refer to.

[0022] The shielding assembly 118 is arranged in the processing chamber 116. The shielding assembly 118 is equipped with the skirt board 180, the perforated cylindrical shape shielding member 142, and the shadow ring 130. Shielding a skirt board 180, the perforated cylindrical shape shielding member 142, and the shadow ring 130 from the effectiveness of deposition of a chamber component, the mutual array of the gas is carried out so that it can be made to pass. The skirt board 180 was secured between the target plate 106 and the retaining ring 112, and is caudad extended into the chamber volume 117.

[0023] The shielding member 142 encloses the mounting eclipse and the skirt board 180 in "J" typeface profile in the retaining ring 112. Termination of the shielding member 142 is carried out at the edge 141.

[0024] The shadow ring 130 appears on an edge 141, when it is in the location where the rise-and-fall system 132 (therefore, electrostatic chuck 136) descended. Moreover, the shadow ring 130 appears on the alignment ring 128, when it is in the location where the rise-and-fall system 132 went up. The shadow ring 130 has the bore chosen so that it might be located on the periphery of the edge of a substrate 120, without the shadow ring 130 contacting a substrate 120.

[0025] The gas panel 170 combined with the processing chamber 116 lets one or the gas inlet 172 beyond it arranged in the chamber wall 114 pass, supplies an argon or other suitable raw gas, and is made to introduce it into the processing chamber 116. The argon which enters into the internal volume 117 enters into the processing field 176 which passes two or more holes 143 in the shielding member 142, and subsequently passes through between a skirt board 180 and the shadow rings 130, and is demarcated by the target plate 106, the electrostatic chuck 136, and the shielding assembly 118.

[0026] The cleaning system 150 is equipped with the RF power source 152 and the matching circuit 154. The RF power source 152 is combined with the matching circuit 154. The matching circuit 154 is combined with 1 of the electrostatic chuck 136, or at least one of the electrodes 134 beyond it. The cleaning system 150 is typically used periodically, in order to remove a contamination from the electrostatic chuck 136 as a part of maintenance program. The cleaning system 150 operates by supplying RF power to one or at least one of the electrodes 134 beyond it, and makes the plasma 177 ignite from the argon supplied to the processing chamber 116 from a gas panel 170. An argon is ionized within the plasma 177, etches substantially the support front face 122 of the electrostatic chuck 136, and removes the contamination which may be deposited on the support front face 122 by it. The example of such a cleaning system — the [of Khurana and others on August 4, 1997 / Europe patent application] — since it is indicated by EP 0865070A1, please refer to.

[0027] The plasma detection system 160 is equipped with the floating contact 162 combined with the measurement device 64. The floating contact 162 is electrically insulated from touch-down (that is, it has floated electrically). Furthermore, the floating contact 162 is put to the processing field 176 of the processing chamber 116 in which the plasma 177 is formed. In the gestalt of 1 operation, the floating contact 162 is the target plate 106. In order to float the target plate 106 from touch-down, please note that a power source 102 must not give a touch-down path into the time amount of plasma detection.

[0028] Drawing 2 shows the gestalt of alternative implementation of the floating contact 162 equipped with the conductive member 204 attached in the processing chamber 116. The conductive member 204 is put to the processing field 176 of the processing chamber 116 in which the plasma 177 is formed. The conductive member 204 is electrically insulated from other chamber demarcation structures 200 (the lid which has demarcated the processing field 176, a target, wall, etc.) by the dielectric insulator 202 so that the conductive member 204 can be floated electrically. The conductive member 204 is combined with the measurement device 164. Actuation of the gestalt of operation shown in drawing 2 will become clear from explanation of actuation of the gestalt of operation of the following drawing 1.

[0029] Returning to drawing 1, the measurement device 164 detects change of the electrical potential difference of the floating contact 162. In the gestalt of 1 operation, the measurement device 164 is a voltmeter. If well versed in a field for the time being, please note being able to measure change of the electrical potential difference of the body (namely, floating contact) by many well-known approaches. Therefore, it should be thought that the activity of a well-known alternate method is within the limits of this invention in the present field for an amplitude measurement.

[0030] Actuation is explained. The electrostatic chuck 136 accumulates a contamination on the support front face 122, while processing two or more substrates 120. A cleaning cycle is started in order to remove a contamination from the support front face 122. For example, cleaning gas like an argon is supplied to the processing chamber 116 from a gas panel 170. About 75W RF power is impressed to electrodes 124 and 126 from the cleaning system 150. The plasma 177 ignites and a contamination is etched from the support front face 122. The plasma 177 carries out induction of the bias voltage (as opposed to touch-down) to the floating contact 162. The electrical potential difference of the floating contact 162 is raised by the plasma 177.

[0031] In the gestalt of 1 operation, induction of the electrical potential difference is carried out to floating contact by the plasma which raises the electrical potential difference of floating contact to the electrical potential difference within the limits of 0 (or several millivolts) to about 3.6 thru/or about 7.0 volts. This electrical potential difference originates in change of a chamber gestalt, a target ingredient and conditions, RF-electrical potential difference, an argon style, etc., and changes in the gestalt of other operations.

[0032] Although the gestalt of various operations incorporating this invention was explained, if well versed in a field for the time being, the gestalt of other various operations can be easily devised within the limits of this invention.

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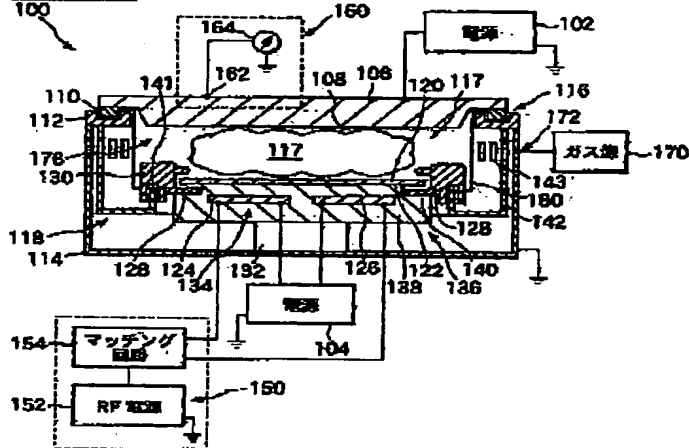
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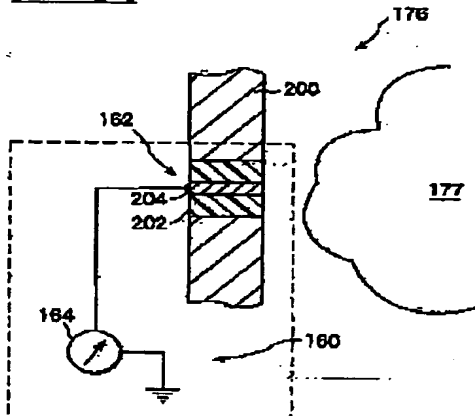
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DRAWINGS

[Drawing 1]

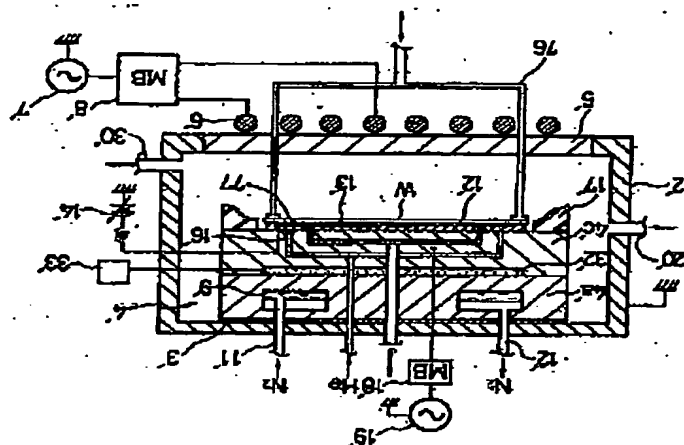


[Drawing 2]

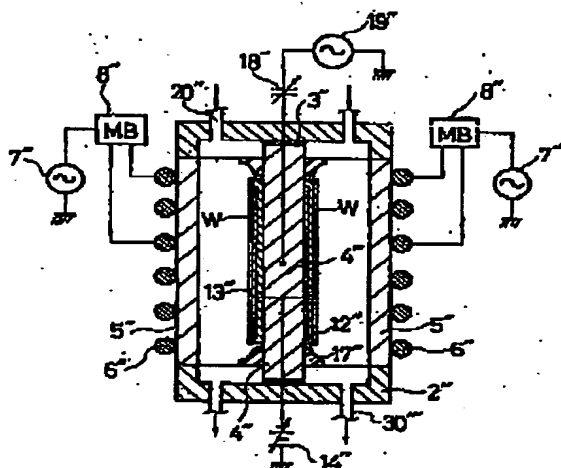


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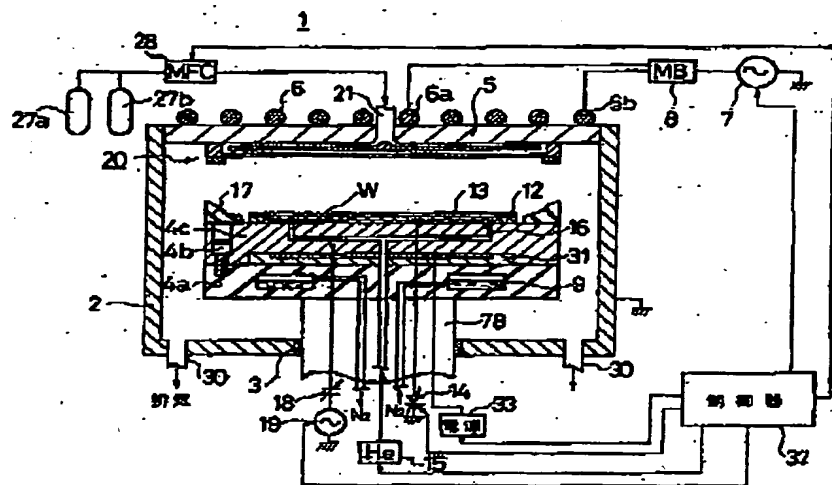
[Drawing 12]



[Drawing 13]



[Drawing 14]



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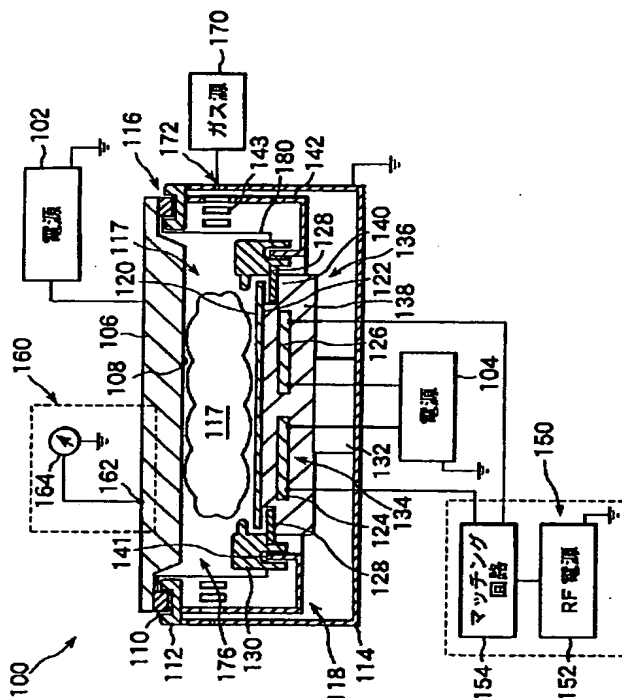
弁理士 中村 稔 (外9名)

(54)【発明の名称】 半導体ウェーハ処理の監視方法及び装置

(57)【要約】

【課題】 プラズマの存在を検出するための方法及び装置を提供する。

【解決手段】 装置は、例えば半導体ウェーハ処理チャンバ116内のプラズマ形成領域に曝され、電氣的に浮いているコンタクト部材を備えている。この浮遊コンタクトは、測定デバイス164に結合されている。プラズマ形成領域内にプラズマ177が存在する場合には、プラズマが浮遊コンタクト162上に電圧を誘起させ、この電圧が測定デバイスによって検出される。



【特許請求の範囲】

【請求項1】 プラズマ処理チャンバ内のプラズマを検出するための装置であって、

上記プラズマに曝された時に電位が変化するように電氣的に浮いているコンタクトと、

上記浮遊コンタクトに結合されている測定デバイスと、を備えていることを特徴とする装置。

【請求項2】 上記浮遊コンタクトは、処理チャンバターゲットからなることを特徴とする請求項1に記載の装置。

【請求項3】 上記浮遊コンタクトは、上記プラズマに曝された時にバイアス電圧を得ることを特徴とする請求項1に記載の装置。

【請求項4】 上記バイアス電圧は、約3.6乃至約7.0ボルトであることを特徴とする請求項3に記載の装置。

【請求項5】 上記測定デバイスは、電圧計を更に備えていることを特徴とする請求項1に記載の装置。

【請求項6】 上記処理チャンバ内に配置されている静電チャック、を更に備えていることを特徴とする請求項1に記載の装置。

【請求項7】 上記浮遊コンタクトは、上記測定デバイスに結合され、上記プラズマに曝されるコンタクト部材と、上記コンタクト部材を上記処理チャンバから電氣的に絶縁する絶縁部材と、を更に備えていることを特徴とする請求項1に記載の装置。

【請求項8】 上記測定デバイスは、電圧計を更に備えていることを特徴とする請求項7に記載の装置。

【請求項9】 プラズマを検出するための装置であって、プラズマ処理領域を画定する壁及び蓋を有する処理チャンバと、上記蓋に近接して配置され、上記プラズマ処理領域に曝されているターゲットと、上記ターゲットに結合されている測定デバイスと、を備えていることを特徴とする装置。

【請求項10】 上記処理チャンバは、上記処理チャンバ内に配置され、少なくとも1つの埋め込まれた電極を有する静電チャック、を更に備えていることを特徴とする請求項9に記載の装置。

【請求項11】 上記処理チャンバは、クリーニングシステム、を更に備えていることを特徴とする請求項9に記載の装置。

【請求項12】 上記ターゲットは、上記プラズマに曝された時にバイアス電圧を得ることを特徴とする請求項9に記載の装置。

【請求項13】 上記バイアス電圧は、約3.6乃至約7.0ボルトであることを特徴とする請求項12に記載

の装置。

【請求項14】 上記測定デバイスは、電圧計を更に備えていることを特徴とする請求項9に記載の装置。

【請求項15】 上記処理チャンバは、物理蒸着チャンバであることを特徴とする請求項9に記載の装置。

【請求項16】 上記ターゲットに結合され、上記クリーニングシステムが付勢された時に接地から電氣的に浮くようになっている電源を更に備えていることを特徴とする請求項11に記載の装置。

10 【請求項17】 処理チャンバ内にプラズマが存在することを検出するための方法であって、上記処理チャンバのプラズマ処理領域に曝されているコンタクトを電氣的に浮かせるステップと、上記処理領域内においてプラズマを点弧させるステップと、上記コンタクトの電圧レベルを測定するステップと、を含むことを特徴とする方法。

【請求項18】 上記コンタクトは、物理蒸着チャンバターゲットであることを特徴とする請求項17に記載の方法。

【請求項19】 上記コンタクトを電氣的に浮かせるステップは、上記ターゲットに結合されている電源を絶縁するステップ、を更に含むことを特徴とする請求項18に記載の方法。

【請求項20】 上記コンタクトの上記電圧レベルは、上記プラズマによって誘起されることを特徴とする請求項17に記載の方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、一般的には、半導体処理チャンバ内の処理を監視するための装置及びそれに関連する方法に関する。詳しく述べれば、本発明は、処理チャンバ内のプラズマを検出する装置に関する。

【0002】

【従来の技術】 多くの半導体処理動作においては、処理中の基板を静止させ続けることが臨界的である。これらの目的を達成するために、静電、機械、及び/または真空チャックのような基板保持デバイスが、基板支持ペDESTALに設けられていて、基板をペDESTALの支持表面に保持するようになっていることが多い。静電チャックは、処理中の付勢及び減勢時間が速く、基板を破損する可能性が低く、そしてウェーハの全表面を露出させるので、保持デバイスとして静電チャックを設けたペDESTALが広く選択されている。

【0003】 静電チャックは、誘電体材料内に埋め込まれた電極に直流電圧を印加することによって動作させる。印加された電圧は静電チャックの支持表面上に電荷を発生させ、この電荷が、支持表面に接する基板の裏側に逆極性の静電電位を誘起させる。この静電電位が、処

理中に基板をベDESTALに固定する。

【0004】支持表面の固有抵抗は、チャッキング及びデチャッキング性能（即ち、支持表面への基板のクランピング、及び支持表面からの基板の解放の繰り返し）にとって重要なパラメータである。支持表面の意図した特性固有抵抗を維持することによって、チャッキング力を弱める電荷の移動及び電流の流れが阻止される。チャック表面上の汚染物はチャックの固有抵抗を増加させ、それによってチャッキング性能を寄生的に変化させることが多い。従って、信頼できるように機能させるためには、静電チャックの支持表面に汚染物が無いようにしなければならない。実質的な電流漏洩が発生するか、または静電チャック内に残留電荷が確立されると、チャッキング力が減少するか、または完全に失われるようになる。

【0005】静電チャック表面汚染の一般的な形状は、チャンバが大気へ通気される時のガスの吸収、またはガスと静電チャックの支持表面（典型的にはセラミック材料）との反応である。残留大気ガスを含む支持表面がウェーハ処理中に高温に曝されると、支持表面全体に低固有抵抗の汚染フィルムが形成される。時間が経過して多くのウェーハの処理中にチャンバが繰り返し通気され、高温に曝されると、汚染フィルムの厚みが増加し、固有抵抗が低下する。汚染物の固有抵抗がセラミックの固有抵抗よりも低い場合には、静電チャックは汚染フィルム自体内に逆極性の電荷をセットアップし始め、汚染フィルムの上の基板には誘起させない。従って、基板とベDESTALとの間のチャッキング力が失われる。

【0006】チャッキング性能に及ぼす汚染フィルムの効果は、汚染フィルムの厚み及び固有抵抗、並びに静電チャックの動作温度に依存する。静電チャックのバルク固有抵抗はその温度に逆比例するので、バルク固有抵抗がより高くなるような低温において、導電性汚染フィルムの効果が一層重大になる。従って、もし高温において弱いチャッキング力が観測されれば、低温においては静電チャックは殆どチャッキング力を呈さなくなる。チャック上への汚染フィルムの形成を支配する主変数は、動作温度、その温度にある間の時間、及び大気へ曝される時間である。

【0007】汚染フィルムは、形成された汚染フィルムが保守手順によって除去されるまで静電チャックの表面上で成長し続ける。保守は定期的に遂行され、汚染フィルムを静電チャック支持表面から除去する。

【0008】1つの保守手順は、その位置のままで（インシット）静電チャックの支持表面から汚染物をスパッタさせる低電力プラズマエッチングからなる。この保守手順を遂行するために、RF電源、自動同調RFマッチング回路、及びサービスクントローラが適用可能なチャンバ上に設置される。チャンバ内へアルゴンガスを流入させながら、静電チャック内の電極にRF電力を印加す

ることによって、処理チャンバ内にプラズマが生成される。チャックはプラズマに対して負にバイアスされており、チャック表面にアルゴンイオンを衝突させ、イオンに汚染物層を“スパッタ”させる。プラズマエッチングが遂行され、全ての汚染物が除去された後の静電チャックは、次の保守サービス間隔まで基板を保持する状態を回復している。

【0009】低電力プラズマエッチングを使用することに伴う1つの問題は、プラズマが点弧したことを、即ちクリーニングまたはエッチングサイクルが開始されたことを確認することが困難なことである。若干の処理チャンバには、チャンバの内部を見ることができるよう窓が設けられている。従って、ユーザはプラズマの“グロー”を見ることによってプラズマの存在を視覚的に識別することができる。しかしながら、全てのチャンバに、プラズマを容易に見ることが出来る位置に窓が設けられているのではなく、他のチャンバには処理キットが取り付けられていて、窓とプラズマを閉じ込めるチャンバの部分との間の視線を遮ることが多い。そのため、プラズマの存在を認証することが極めて困難であることが多い。

【0010】もし静電チャックからの汚染物の除去に成功しなければ、クリーニングプロセスを繰り返さなければならない。保守手順のこの繰り返しは、処理チャンバのダウン時間を増加させ、そして相応して生産スループットを低下させる。従って、当分野においては、半導体処理チャンバ内のプラズマの検出を容易にする装置に対する要望が存在している。

【0011】

【発明の概要】従来技術に伴う欠陥は、半導体処理チャンバ内にプラズマが存在することを容易に決定するプラズマ検出システムによって解消される。プラズマ検出システムは、測定デバイスに結合されていて処理チャンバのプラズマ形成領域に曝されている浮遊コンタクト（即ち、接地から電気的に“浮いて”いるコンタクト）を備えている。測定デバイスは、プラズマがプラズマ形成領域内で点弧した場合の、従って処理チャンバ内にプラズマが存在していることを指示する浮遊コンタクト上の電圧の増加を検出する。

【0012】処理チャンバ内のプラズマの存在を検出する方法も開示する。本方法は、処理チャンバのプラズマ形成領域に曝されているコンタクトを電気的に浮かせるステップと、プラズマ形成領域内でプラズマを点弧させるステップと、コンタクトの電圧レベルを測定するステップとを含む。

【0013】本発明は、以下の添付図面を参照しての説明から容易に理解することができよう。理解を容易にするために、可能な限り、両図に共通な同一要素には同一の番号を付してある。

【0014】

【実施の形態】図1は、半導体ウェーハ処理システム1

00内に組み込まれている本発明のプラズマ検出システム160を示す概要図である。本発明は、半導体処理システム100内にプラズマが存在することを効果的に指示する。本発明は、一般的に、例えば物理蒸着(PVD)即ちスパッタリングチャンバ、化学蒸着(CVD)チャンバ、及びイオン注入チャンバを含む半導体ウェーハ処理システムの堆積チャンバに適用可能である。また本発明は、プラズマ処理即ちクリーニングサイクルを有するチャンバ内に基板を保持するために、静電チャックが使用されているならば適用可能である。

【0015】例として、図1は、PVD即ちスパッタリングシステム100の概要を示す図である。システム100は、処理チャンバ116、ガスパネル170、クリーニングシステム150、及びプラズマ検出システム160を含んでいる。基板120(例えば、半導体ウェーハ)は、処理中に処理チャンバ116内に位置決めされている。真空ポンプのような普通のハードウェア成分は、明瞭化のために省略してあることに注目されたい。

【0016】例示した処理チャンバ116は、接地された円筒形チャンバ壁114、及びチャンバ壁114のトップに取付けられている支持リング112を含んでいる。ターゲット板106はチャンバ壁114上に配置され、処理チャンバ116を閉じて内部容積117を画定している。ターゲット板106は、ターゲット板106と支持リング112とを分離している環状絶縁体110によって、チャンバ壁114から電気的に絶縁されている。一般的に、処理チャンバ116内の真空の完全性を保証するために、絶縁体110の上及び下にOリング(図示してない)を使用して真空シールを構成している。

【0017】ターゲット板106は、堆積種になる材料で製造することも、または堆積種のコーティング108を含むこともできる。スパッタリングプロセスを容易にするために、ターゲット板106と電気的に接地されているチャンバ壁114との間に高電圧直流電源102が接続されている。

【0018】静電チャック136は、基板120を処理チャンバ116内に保持し、支持する。静電チャック136は、静電チャック136を垂直に運動させる昇降システム132上に取付けられている。静電チャック136の周縁からフランジ140が伸びていて、位置合わせリング128を支持している。

【0019】本発明の一実施の形態においては、静電チャック136は、セラミックチャックボディ138内に埋め込まれている1つまたはそれ以上の電極134、例えば第1の電極124、及び第2の電極126を含んでいる。電極124及び126は、普通の手法で電極電源104からの電圧によって駆動され、電圧の印加にตอบสนองして、基板120を静電チャック136の支持表面122に静電的にクランプする。

【0020】セラミックチャックボディ138は、例えば、窒化アルミニウムまたは窒化ホウ素で製造されている。このような比較的低固有抵抗の材料は、高温処理中にジョンセン・ラーベック効果を促進する。酸化チタンまたは酸化クロムでドーブしたアルミナのような他の比較的低固有抵抗セラミックも、有用な高温チャック材料を形成する。もし静電チャック138を低温に限って使用するのであれば、アルミナのような他のセラミック及び/または誘電性材料を使用してチャックボディ138を形成する。

【0021】セラミック静電チャックの例が1992年5月26日付米国特許第5,117,121号、及び1997年8月12日付米国特許第5,656,093号に開示されているので参照されたい。非セラミック静電チャックの例が1980年1月15日付米国特許第4,184,188号、及び1983年5月24日付米国特許第4,384,918号に開示されているので参照されたい。

【0022】シールドアセンブリ118が、処理チャンバ116内に配置されている。シールドアセンブリ118は、スカート180、有孔円筒形シールド部材142、及びシャドウリング130を備えている。スカート180、有孔円筒形シールド部材142、及びシャドウリング130は、チャンバ成分を堆積の効果からシールドしながら、ガスは通過させることができるように交互配列されている。スカート180は、ターゲット板106と支持リング112との間に確保され、チャンバ容積117内へ下方に伸びている。

【0023】シールド部材142は支持リング112に取り付けられ、スカート180を“J”字形プロファイルで取り囲んでいる。シールド部材142は、端141で終端している。

【0024】シャドウリング130は、昇降システム132(従って、静電チャック136)が下降した位置にある時には端141上に載るようになっている。またシャドウリング130は、昇降システム132が上昇した位置にある時には位置合わせリング128上に載るようになっている。シャドウリング130は、シャドウリング130が基板120に接触することなく、基板120の縁の周縁の上に位置するように選択された内径を有している。

【0025】処理チャンバ116に結合されているガスパネル170は、チャンバ壁114内に配置されている1つまたはそれ以上のガス入口172を通して、アルゴンまたは他の適当な処理ガスを供給して処理チャンバ116内へ導入させる。内部容積117内へ入るアルゴンは、シールド部材142内の複数の孔143を通過し、次いでスカート180とシャドウリング130との間を通過し、そしてターゲット板106、静電チャック136、及びシールドアセンブリ118によって画定されて

いる処理領域176内へ入る。

【0026】クリーニングシステム150は、RF電源152、及びマッチング回路154を備えている。RF電源152は、マッチング回路154に結合されている。マッチング回路154は、静電チャック136内の1つまたはそれ以上の電極134の少なくとも1つに結合されている。クリーニングシステム150は、保守プログラムの一部として静電チャック136から汚染物を除去するために、典型的には定期的に使用される。クリーニングシステム150は、1つまたはそれ以上の電極134の少なくとも1つにRF電力を供給することによって動作し、ガスパネル170から処理チャンバ116へ供給されるアルゴンからプラズマ177を点弧させる。アルゴンはプラズマ177内でイオン化されて静電チャック136の支持表面122を実質的にエッチングし、それによって支持表面122上に堆積され得る汚染物を除去する。このようなクリーニングシステムの例が、1997年8月4日付Khuranaらの欧州特許出願第EP0865070A1に開示されているので参照されたい。

【0027】プラズマ検出システム160は、測定デバイス64に結合されている浮遊コンタクト162を備えている。浮遊コンタクト162は、接地から電氣的に絶縁されている（即ち、電氣的に浮いている）。更に浮遊コンタクト162は、プラズマ177が形成される処理チャンバ116の処理領域176に曝されている。一実施の形態においては、浮遊コンタクト162は、ターゲット板106である。ターゲット板106を接地から浮かせるために、プラズマ検出の時間中に、電源102が接地通路を与えてはならないことに注目されたい。

【0028】図2は、処理チャンバ116に取付けられている導電性部材204を備えた浮遊コンタクト162の代替実施の形態を示している。導電性部材204は、プラズマ177が形成されている処理チャンバ116の処理領域176に曝されている。導電性部材204は、導電性部材204を電氣的に浮かせることができるように、誘電性絶縁体202によって他のチャンバ画定構造200（処理領域176を画している蓋、ターゲット、壁等）から電氣的に絶縁されている。導電性部材204は、測定デバイス164に結合されている。図2に示す実施の形態の動作は、以下の図1の実施の形態の動作の説明から明白になるであろう。

【0029】図1に戻って、測定デバイス164は、浮遊コンタクト162の電圧の変化を検出する。一実施の形態においては、測定デバイス164は電圧計である。当分野に精通していれば、多くの公知方法によってボディ（即ち、浮遊コンタクト）の電圧の変化を測定することに注目されたい。従って、電圧測定のための当分野において公知の代替方法の使用は、本発明の範囲内にあるものと考えべきである。

【0030】動作を説明する。静電チャック136は、複数の基板120を処理している間に支持表面122上に汚染物を累積する。支持表面122から汚染物を除去するために、クリーニングサイクルが開始される。例えばアルゴンのようなクリーニングガスが、ガスパネル170から処理チャンバ116へ供給される。約75ワットのRF電力が、クリーニングシステム150から電極124及び126に印加される。プラズマ177が点弧し、支持表面122から汚染物がエッチングされる。プラズマ177は、浮遊コンタクト162にバイアス電圧（接地に対して）を誘起させる。浮遊コンタクト162の電圧は、プラズマ177によって上昇させられる。

【0031】一実施の形態においては、浮遊コンタクトの電圧を0（または数ミリボルト）から、約3.6乃至約7.0ボルトの範囲内の電圧まで上昇させるプラズマによって、浮遊コンタクトに電圧が誘起される。この電圧は、チャンバ形態、ターゲット材料及び条件、RF電圧、アルゴン流等の変化に起因して、他の実施の形態においては変化する。

【0032】本発明を組み込んだいろいろな実施の形態を説明したが、当分野に精通していれば本発明の範囲内で他のさまざまな実施の形態を容易に考案することができよう。

【図面の簡単な説明】

【図1】プラズマ検出システムを備えている半導体処理チャンバの概要図である。

【図2】プラズマ検出システムの代替実施の形態の部分断面図である。

【符号の説明】

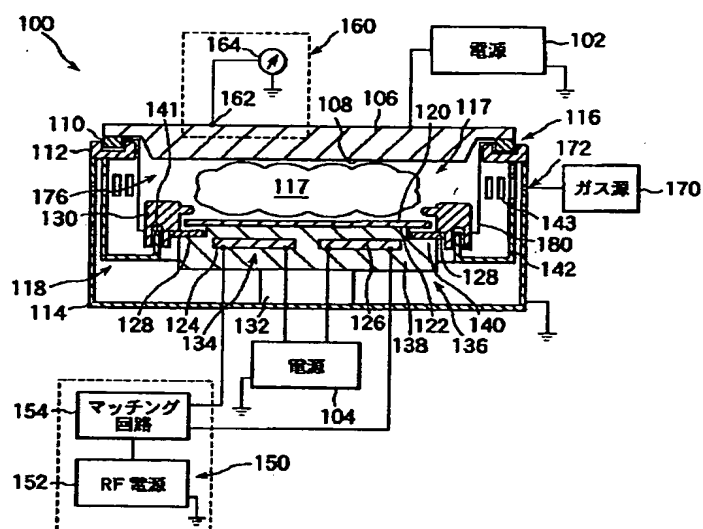
- 100 半導体ウェーハ処理システム（PVDシステム）
- 102 高電圧直流電源
- 104 電極電源
- 106 ターゲット板
- 108 堆積種コーティング
- 110 環状絶縁体
- 112 支持リング
- 114 チャンバ壁
- 116 処理チャンバ
- 117 内部容積
- 118 シールドアセンブリ
- 120 基板
- 122 支持表面
- 124 第1の電極
- 126 第2の電極
- 128 位置合わせリング
- 130 シャドウリング
- 132 昇降システム
- 134 電極
- 136 静電チャック

138 チャックボディ
 140 フランジ
 141 シールド部材の端
 142 シールド部材
 143 孔
 150 クリーニングシステム
 152 RF電源
 154 マッチング回路
 160 プラズマ検出システム
 162 浮遊コンタクト

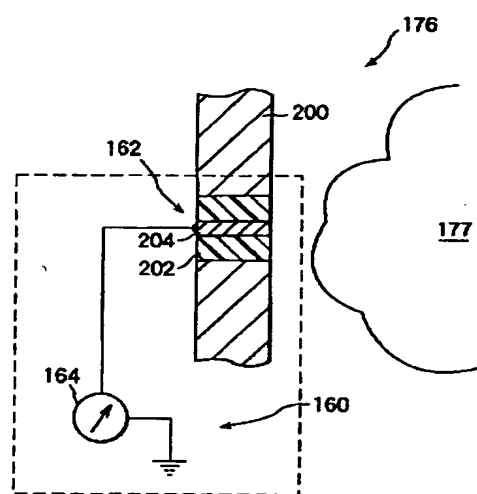
* 164 測定デバイス
 170 ガスパネル
 172 ガス入口
 176 処理領域
 177 プラズマ
 180 スカート
 200 チャンバ画定構造
 202 絶縁体
 204 導電性部分

* 10

【図1】



【図2】



【外国語明細書】

METHOD AND APPARATUS FOR SEMICONDUCTOR WAFER
PROCESS MONITORINGBACKGROUND OF THE DISCLOSURE

1. Field of Invention

The present invention relates generally to an apparatus and concomitant method for monitoring processes in a semiconductor process chamber. More specifically, the invention relates to an apparatus that detects a plasma in the process chamber.

2. Background of Invention

During many semiconductor processing operations, it is critical to maintain a substrate stationary during processing. To achieve these ends, substrate support pedestals often are equipped with substrate retaining devices such as electrostatic, mechanical, and/or vacuum chucks in order to hold the substrate to a support surface of the pedestal. Pedestals equipped with electrostatic chucks are commonly chosen as retaining devices because of their rapid activation and deactivation times, low likelihood of substrate damage and exposure of the entire wafer face during processing.

Electrostatic chucks operate by supplying DC voltage to an embedded electrode within a dielectric material. The applied voltage produces a charge on the support surface of the electrostatic chuck, which in turn induces an electrostatic potential of opposite polarity on a backside of the substrate adjacent the support surface. This electrostatic potential affixes a substrate to the pedestal during processing.

The resistivity of the support surface is an important parameter for chucking and de-chucking

performance (i.e., the repeated clamping and releasing of the substrate from the support surface). Maintaining an intended characteristic resistivity at the support surface prevents charge migration and current flow that degrades the chucking force. Contaminants upon the chuck surface often increase the resistivity of the chuck thereby parasitically altering the chucking performance. As such, the support surface of the electrostatic chuck must be free of contaminants in order to function reliably. Once substantial current leakage occurs or a residual charge is established within the electrostatic chuck, the result is a reduced or total loss of chucking force.

A common form of electrostatic chuck surface contamination is the absorption of gases, or their reaction with the support surface of the electrostatic chuck (typically a ceramic material), when the process chamber is vented to atmosphere. The exposure of the support surface containing residual atmospheric gases to high temperatures during wafer processing creates a low resistance contamination film across the support surface. Over time, the repeated venting of the chamber and exposure to elevated temperatures during processing multiply wafers, the contamination film increases in thickness and decreases in resistance. When the resistivity of the contamination film is lower than that of the ceramic, the electrostatic chuck begins to set up the opposite polarity charge in the contamination film itself, and not the substrate on top of the contamination film. Thus, chucking force between the substrate and the pedestal is lost.

The impact of the contamination film on chucking performance depends on the thickness and resistivity of the contamination film as well as the operating

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temperature of the electrostatic chuck. Because the bulk resistivity of the electrostatic chuck material is inversely proportional to its temperature, the impact of the conductive contamination film is more severe at lower temperatures where the bulk resistivity is higher. Hence, if weak chucking force is observed at higher temperatures, the electrostatic chuck will exhibit almost no chucking force at lower temperatures. The primary variables which govern the formation of a contamination film on the chuck are operating temperature, time at temperature, and time of exposure to atmosphere.

The contamination film will continue to grow on the surface of the electrostatic chuck until the formed contamination film is removed by a maintenance procedure. Maintenance is performed periodically to remove contaminant films from the electrostatic chuck support surface.

One maintenance procedure consists of a low power in-situ plasma etch which sputters contaminants off the support surface of the electrostatic chuck. To perform this maintenance procedure, an RF generator, an auto-tuning RF match, and a service controller are installed on the applicable chamber. A plasma is generated within process chamber by applying RF power to the electrodes within the electrostatic chuck, while flowing argon gas into the chamber. Negative bias on the chuck, with respect to the plasma, causes argon ion bombardment of the chuck surface, wherein the ions "sputter" off the contaminant layer. After the plasma etch has been performed and all contaminants have been removed, the electrostatic chuck has been restored to a condition to run substrates until the next maintenance service interval.

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One problem associated with using low power plasma etching is the difficulty in confirming that the plasma has been struck, initiating the cleaning, or etch cycle. Some process chambers are equipped with windows that allow viewing of the interior of the chamber. Thus, a user may be able to visually identify the presence of the plasma by viewing the plasma "glow". However, not all chambers have the window positioned to allow for easy viewing of the plasma, while other chambers are fitted with process kits that frequently obstruct the line of sight between the window and the portion of the chamber containing the plasma. As such, verification of the presence of the plasma is often very difficult.

If the removal of the contaminants from the electrostatic chuck is not successful, the cleaning process must be repeated. This repetition of the maintenance procedure leads to increased process chamber downtime, and correspondingly, reduced product throughput. Therefore, there is a need in the art for an apparatus that facilitates the detection of plasma in a semiconductor process chamber.

SUMMARY OF INVENTION

The disadvantages associated with the prior art are overcome by a plasma detection system that facilitates determining a presence of a plasma within a semiconductor process chamber. A plasma detection system comprises a floating contact, i.e., electrically "floating" from ground, exposed to a plasma forming region of a process chamber and coupled to a measuring device. The measuring device detects an increase in voltage on the floating contact when the plasma is struck in the plasma forming

region, thus indicating the presence of the plasma in the process chamber.

A method for detecting presence of a plasma in a processing chamber is also disclosed. The method comprises the steps of electrically floating a contact exposed to a plasma forming region of the processing chamber, striking a plasma in the plasma forming region and measuring a voltage level of the contact.

BRIEF DESCRIPTION OF DRAWINGS

The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

Fig. 1 is a simplified schematic of a semiconductor process chamber comprising a plasma detection system; and,

Fig. 2 is a partial cross sectional view of an alternate embodiment of a plasma detection system.

To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAIL DESCRIPTION OF INVENTION

FIG. 1 is a simplified schematic drawing illustrating a plasma detection system 160 of the present invention incorporated in a semiconductor wafer processing system 100. The invention effectively indicates when a plasma is present in the semiconductor processing system 100. The invention is generally applicable to deposition chambers of semiconductor wafer processing systems, including, for example, physical vapor deposition (PVD) or

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sputtering chambers, chemical vapor deposition (CVD) chambers, and ion implant chambers. The invention is also applicable wherever an electrostatic chuck is used to retain a substrate within the chamber having plasma processing or cleaning cycles.

By way of example, FIG. 1 schematically illustrates a PVD or sputtering system 100. The system 100 contains a process chamber 116, a gas panel 170, a cleaning system 150 and a plasma detection system 160. The substrate 120 (e.g., a semiconductor wafer) is positioned within the process chamber 116 during processing. Please note, conventional hardware components such as vacuum pumps are omitted for clarity.

The exemplary process chamber 116 includes a grounded, cylindrical chamber wall 114 and a support ring 112 that is mounted to the top of the chamber wall 114. A target plate 106 is disposed upon the chamber wall 114 and closes the process chamber 116, defining an interior volume 117. The target plate 106 is electrically insulated from the chamber walls 114 by an annular insulator 110 that separates the target plate 106 and the support ring 112. Generally, to ensure the integrity of the vacuum in the process chamber 116, O-rings (not shown) are used above and below the insulator 110 to provide a vacuum seal.

The target plate 106 may be fabricated of a material that will become the deposition species or it may contain a coating 108 of the deposition species. To facilitate the sputtering process, a high voltage DC power source 102 is connected between the target 106 and the electrically grounded chamber walls 114.

An electrostatic chuck 136 retains and supports the substrate 120 within the process chamber 116. The

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electrostatic chuck 136 is mounted upon an elevator system 132 that provides vertical motion to the electrostatic chuck 136. A flange 140 extends from the perimeter of the electrostatic chuck 136 and supports an alignment ring 128.

In one embodiment of the invention, the electrostatic chuck 136 contains one or more electrodes 134, for example, a first electrode 124 and a second electrode 126, imbedded within a ceramic chuck body 138. In a conventional manner, the electrodes 124 and 126 are driven by voltage from an electrode power source 104 and, in response to application of the voltage, the substrate 120 is electrostatically clamped to the support surface 122 of the electrostatic chuck 136.

The ceramic chuck body 138 is, for example, fabricated of aluminum-nitride or boron-nitride. Such a relatively low resistivity material promotes the Johnsen-Rahbek effect during high temperature processing. Other relatively low resistivity ceramics also form useful high temperature chuck materials such as alumina doped with a titanium oxide or a chromium oxide. If the electrostatic chuck 138 is to be used at low temperatures only, then other ceramic and/or dielectric materials such as alumina are used to form the chuck body 138.

An illustrative ceramic electrostatic chuck is disclosed in U.S. Patent No. 5,117,121, issued May 26, 1992, and U.S. Patent No. 5,656,093, issued August 12, 1997, both of which are herein incorporated by reference. Examples of non-ceramic electrostatic chucks are disclosed in U.S. Patent No. 4,184,188, issued January 15, 1980 and U.S. Patent No. 4,384,918, issued May 24, 1983, both of which are incorporated herein by reference.

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A shield assembly 118 is disposed within the process chamber 116. The shield assembly 118 comprises a skirt 180, a perforated cylindrical shield member 142, and a shadow ring 130. The skirt 180, shield member 142 and the shadow ring 130 are inter-leafed as to allow gas passage and while shielding chamber components from the effects of deposition. The skirt 180 is secured between the target plate 106 and the support ring 112, and extends downward into the chamber volume 117.

The shield member 142 is affixed to the support ring 112 and circumscribes the skirt 180 in a "J" profile. The shield member 142 terminates in an end 141.

The shadow ring 130 rests upon the end 141 when the elevator system 132 (and thus the electrostatic chuck 136) is in a lowered position. The shadow ring 130 alternately rests upon the alignment ring 128 when the elevator system is in an upper position. The shadow ring 130 has an inner diameter selected so that the shadow ring 130 fits peripherally over the edge of the substrate 120 without contacting the substrate 120.

The gas panel 170 is coupled to process chamber 116 and supplies argon or other suitable process gases to enter process chamber 116 through one or more gas inlets 172 disposed about the chamber walls 114. Argon, entering the interior volume 117, passes through a plurality of perforations 143 in the shield member 142, then passes between the skirt 180 and shadow ring 130, and enters a processing region 176 defined by the target plate 106, electrostatic chuck 136 and the shield assembly 118.

The cleaning system 150 comprises an RF generator 152 and a matching circuit 154. The RF generator 152 is coupled to the matching circuit 154. The matching circuit is coupled to at least one of the one or more electrodes

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134 within the electrostatic chuck 136. The cleaning system 150 is typically utilized periodically to remove contaminants from the electrostatic chuck 136 as part of a maintenance program. The cleaning system 150 operates by applying RF power to the at least one of the one or more electrodes 134, striking a plasma 177 from argon supplied to the process chamber 116 from the gas panel 170. The argon is ionized in the plasma 177 and subsequently etches the support surface 122 of the electrostatic chuck 136, thus removing contaminants that may be disposed upon the support surface 122. An example of such a cleaning system is described in the commonly assigned European Patent Application No. EP0865070A1, filed August 04, 1997, by Khurana et al., and is hereby incorporated by reference in its entirety.

The plasma detection system 160 comprises a floating contact 162 coupled to a measuring device 164. The floating contact 162 is electrically isolated from ground (i.e., electrically floating). The floating contact 162 additionally is exposed to the processing region 176 of the process chamber 116 in which the plasma 177 is formed. In one embodiment, the floating contact 162 is the target plate 106. Note that in order for the target plate 106 to float from ground, the power source 102 must not provide a ground path during time of plasma detection.

Depicted in Fig. 2 is an alternate embodiment of the floating contact 162 comprising a conductive member 204 affixed to the process chamber 116. The conductive member 204 is exposed to the processing region 176 of the process chamber 116 in which the plasma 177 is formed. The conductive member 204 is electrically isolated from other chamber defining structures 200 (lid, targets, walls, and the like which bound the processing region 176) by a

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dielectric insulator 202 as to allow the conductive member 204 to electrically float. The conductive member 204 is coupled to the measuring device 164. The operation of the embodiment depicted in Fig. 2 follows as described in the discussion of the embodiment depicted in Fig. 1 below.

Returning to Fig. 1, the measuring device 164 detects a change in voltage of the floating contact 162. In one embodiment, the measuring device 164 is a voltmeter. Please note that one skilled in the art may measure a change in voltage of a body (i.e., the floating contact) through numerous well-known methods. As such, the use of alternate methods for determining voltage measurements that are well-known in the art, should be considered within the scope of the teachings described herein.

In operation, the electrostatic chuck 136 accumulates contamination on the support surface 122 during processing a plurality of substrates 120. To remove the contamination from the support surface 122, a cleaning cycle is initiated. A cleaning gas, for example argon, is supplied to the process chamber 116 from the gas panel 170. RF power from the cleaning system 150 of approximately 75 Watts is applied to the electrodes 124 and 126. Plasma 177 is struck and the contaminants are etched from the support surface 122. The plasma 177 induces a bias voltage to the floating contact 162 with respect to ground. The floating contact 162 experiences a voltage rise due to the plasma 177.

In one embodiment, the floating contact is induced with a voltage by the plasma that causes a rise in the voltage of the floating contact from zero (or trace millivolts) to a voltage in the range of about 3.6 to about 7.0 volts. The voltage will vary in other embodiments due to changes in the chamber configuration,

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target material and condition, RF voltage, argon flow and the like.

Although various embodiments which incorporate the teachings of the present invention have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings.

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What is claimed is:

1. Apparatus for detecting a plasma in a plasma processing chamber, said apparatus comprising:

an electrically floating contact, said floating contact changing in electrical potential when exposed to said plasma; and

a measuring device coupled to said floating contact.

2. The apparatus of claim 1 wherein the floating contact further comprises a process chamber target.

3. The apparatus of claim 1 wherein the floating contact obtains a bias voltage when exposed to said plasma.

4. The apparatus of claim 3 wherein said bias voltage is about 3.6 to about 7.0 volts.

5. The apparatus of claim 1 wherein said measuring device further comprises a voltmeter.

6. The apparatus of claim 1 further comprising:

an electrostatic chuck disposed within said process chamber.

7. The apparatus of claim 1 wherein said floating contact further comprises:

a contact member coupled to said measuring device and exposed to said plasma; and

an insulating member that electrically insulates said contact member from said processing chamber.

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8. The apparatus of claim 7 wherein said measuring device is a voltmeter.

9. Apparatus for detecting plasma comprising:

a process chamber having walls and a lid defining a plasma processing region;

a target disposed proximate said lid, said target exposed to said plasma processing region; and,

a measuring device coupled to said target.

10. The apparatus of claim 9 wherein said process chamber further comprises:

an electrostatic chuck having at least one embedded electrode, said electrostatic chuck disposed within said process chamber.

11. The apparatus of claim 9 wherein said process chamber further comprises:

a cleaning system.

12. The apparatus of claim 9 wherein the target obtains a bias voltage when exposed to said plasma.

13. The apparatus of claim 12 wherein said bias voltage is about 3.6 to about 7.0 volts.

14. The apparatus of claim 9 wherein said measuring device further comprises a voltmeter.

15. The apparatus of claim 9 wherein said process chamber is a physical vapor deposition chamber.

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16. The apparatus of claim 11 further comprising:

a power source coupled to said target wherein said power source electrically floats from ground when said cleaning system is energized.

17. A method for detecting presence of a plasma in a processing chamber, the method comprising the steps of:

electrically floating a contact exposed to a plasma processing region of said processing chamber;

striking a plasma in said plasma processing region;

and,

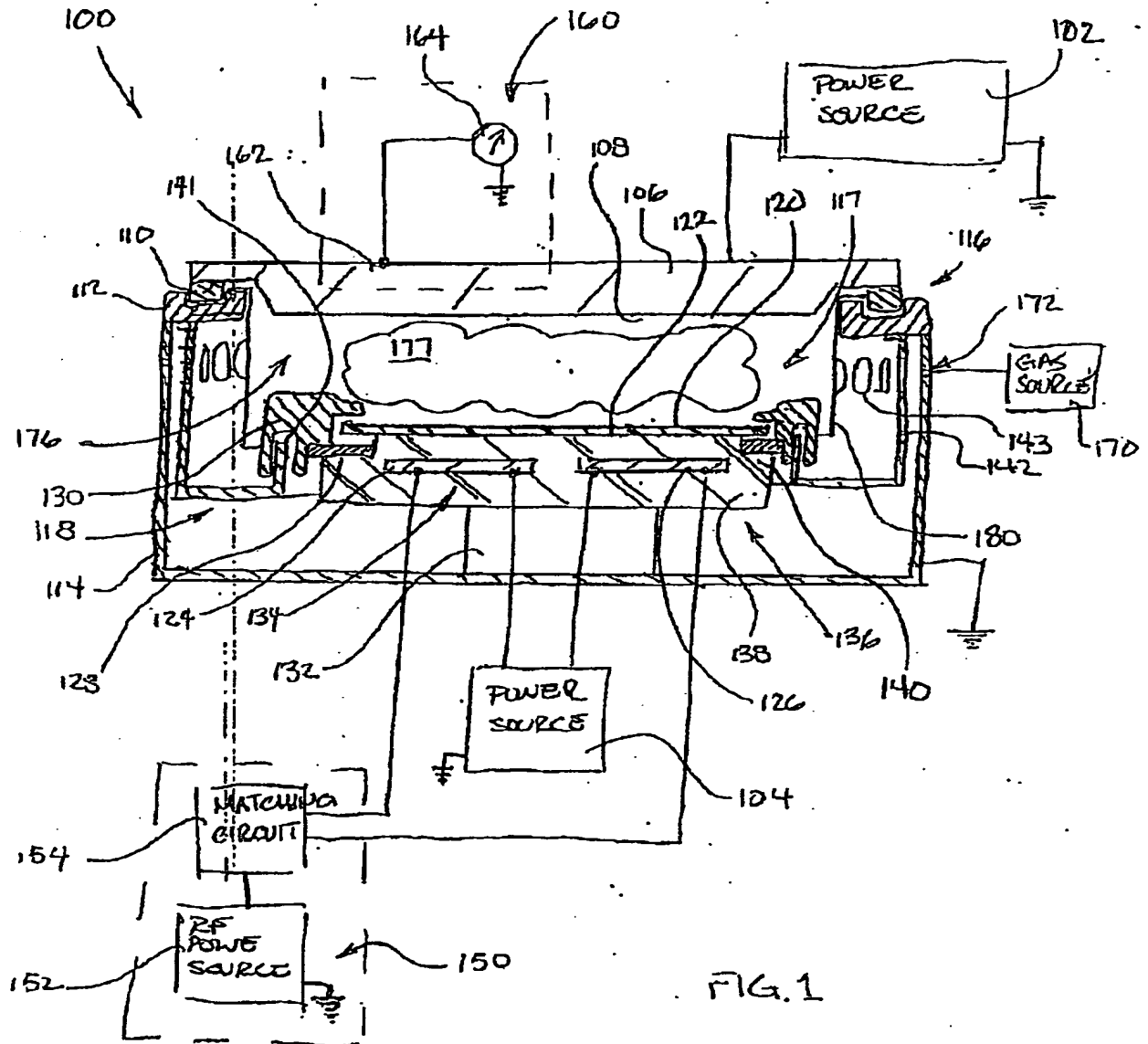
measuring a voltage level of said contact.

18. The method of 17 wherein the contact is a physical vapor deposition chamber target.

19. The method of claim 18 wherein the step of electrically floating said contact further comprises:

isolating a power source coupled to said target.

20. The method of claim 17 wherein said voltage level of said contact is induced by said plasma.



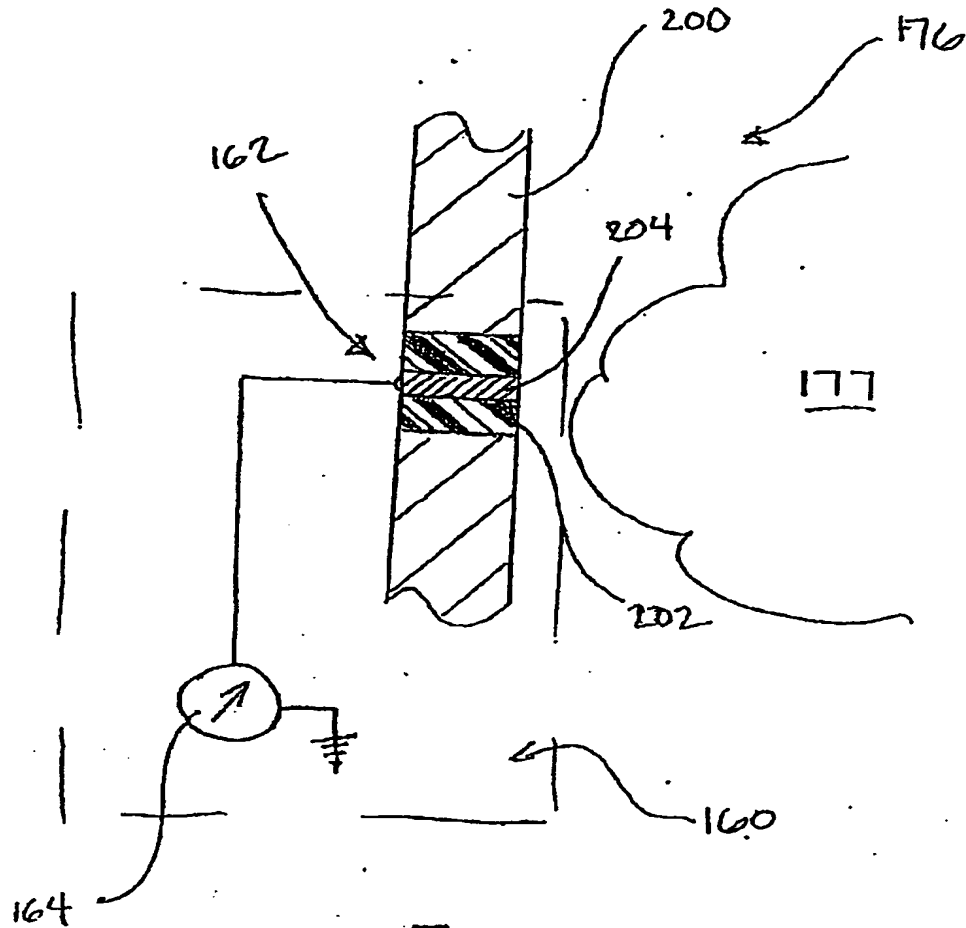


FIG. 2

ABSTRACT

A method and apparatus for detecting the presence of a plasma. The apparatus comprises an electrically floating contact member that is exposed to a plasma forming region, for example, a semiconductor wafer processing chamber. The floating contact is coupled to a measuring device. When a plasma is present in the plasma forming region, the plasma induces a voltage upon the floating contact which is detected by the measuring device.